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Yosemite National Park: the continuous evolution of human–black bear conflict management

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HUMAN–BEAR CONFLICTS are all too common throughout much of the United States (Ziegltrum 2008) and the world (Lemelin 2008, Worthy and Foggin 2008). Typically, they are a result of the availability of human food and garbage to bears (Beckmann and Lackey 2008, Thiemann et al. 2008). As people continue to build homes farther into the wildland–urban interface, the level of conflicts with bears can be expected only to increase (Conover 2008). Despite the widespread range of human–bear conflict, there is no place with quite the same problem as the Sierra Nevada mountain range of California, particularly in Yosemite National Park.

Yosemite National Park encompasses >3,077 km² and attracts nearly 3.5 million visitors annually. Each year, >90% of visitors converge on the 18-km² area of the park known as Yosemite Valley, and approximately 77% of the park's human–bear conflicts occur in this area (National Park Service 1999, 2000, 2001a, 2002, 2003, 2005, 2006, 2007, 2008). Yosemite Valley has >400 campsites and almost 1,300 other lodging units, including hotel rooms, cabins, and canvas tents. In addition, there are several housing developments for national park and concessionaire employees.

Yosemite has a long and complex history of human and bear management. Although this article will attempt to discuss key moments in that history and in the current management policies, it is not intended to be an exhaustive account.

A brief history of bear management in Yosemite (1890–1998)

When Yosemite became a national park in 1890, it was inhabited by both grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*). That soon ended as the last grizzly bear was killed in the park in 1895. Historic records indicate that as early as 1917, park managers

were attempting to deal with conflicts with black bears within the park. Since that time, the degree of conflict began to rise as visitation to the park and the availability of human food and garbage increased. In 1937, park managers set up artificial feeding sites in the west end of the valley to reduce human–bear conflicts in the more developed east end of Yosemite Valley. In the 1930s, artificial feeding sites, along with open garbage dumps throughout the park, increased the number of black bears inhabiting Yosemite Valley during the summer to an estimated 60 individuals, or approximately 3 bears per km² (National Park Service, unpublished report). This represents a very high density when compared to other documented Sierra Nevada bear populations.

Bear conditioning to human food is historically common in the national parks, and Yosemite is no exception. Photos taken in Yosemite as early as the 1920s depict park visitors hand-feeding black bears and bears “begging” for food along roadways. Like bears elsewhere, black bears in Yosemite regularly raided campsites and became skilled at locating and obtaining unsecured human food and garbage. However, black bears in Yosemite went beyond begging for food. In the 1920s, the first documented incident of a bear breaking into a vehicle occurred (National Park Service, unpublished report). After this early incident, the ability of many Yosemite black bears to break into vehicles slowly increased until the late 1960s and early 1970s when the park permanently closed all open-pit dumps. At that time, bears began to focus more on the campgrounds and vehicles to obtain readily-available human food and garbage to replace the food from garbage dumps that was no longer available (National Park Service, unpublished report).

Just as sows teach their cubs to forage for natural foods seasonally, they began to teach their cubs how to forage for human food in campgrounds and vehicles. In addition,



Bear rummages for food in a parked car storage-carrier.

anecdotal evidence suggests another way that naïve bears may learn to focus on vehicles as a potential food source. After a food-conditioned bear breaks into a vehicle containing food or garbage and subsequently leaves the area, other bears that have not associated vehicles with a potential food source obtain food from the damaged vehicle. Over time, these naïve bears develop the ability and strategy of obtaining food from vehicles.

To illustrate how food conditioning in bears develops, in 1999 a female bear that was previously unknown to wildlife management personnel was first seen spending time in the woods outside of developed areas in Yosemite Valley. When she was seen again, it was within a developed area of the park near a campground. She subsequently was captured, tagged, and radio-collared so that she could more easily be tracked. Later that summer, during routine bear management patrols, park personnel saw the bear obtaining improperly-stored human food from the open bed of a pickup truck in a campground parking lot. As soon as she was observed, she was chased out of the area. A few weeks later, she caused damage to a camper shell while gaining entry, and, once again, she obtained human food. Throughout the remainder of the summer, paw prints and scratches on the windows and doors of vehicles were found periodically within the area she generally frequented. Observations and radio-tracking indicated she was responsible for these incidents, but she was unable to gain entry into hard-sided vehicles. However, over the course of the next couple of months, she learned how

to bend down the door frames of vehicles until the windows broke out, providing her access to the interiors and to whatever human food contained within the vehicles. While this example certainly does not illustrate scientifically defensible proof about the progressive learning of naïve bears to break into vehicles, it does provide a reasonable depiction of individual bear behavior from a natural state to one of human food-conditioning.

In response to growing human–bear conflicts, the National Park Service initiated the Bear Management Program in 1975. Its mission was to restore the park’s black bear population to a more natural diet, behavior, and population size (National Park Service, unpublished report). One of the first steps in the program was to convert all of the dumpsters within the park to bear-resistant designs. A campaign also was begun to better educate visitors about bears. Then, in the late 1970s and 1980s, the park installed bear-resistant food storage lockers in campgrounds throughout the park.

By 1998, all campsites and major trailheads throughout the park were equipped with bear-resistant food-storage lockers through the generous support of the National Park Foundation and the Yosemite Fund. However, the level of human–bear conflicts continued to rise, with vehicle incidents comprising an increasing percentage of the incidents. Although the park recognized the need for additional emphasis on countering human–bear conflicts, there was not enough funding to address the myriad of issues.

Current management (1998 to present)

During 1998, there were 1,584 bear incidents, resulting in >\$650,000 of property damage (National Park Service 1999). Of those incidents, 85% involved damage to vehicles by bears in search of food. This high level of incidents and damage caught the attention of the U.S. Congress, and, beginning in 1999, the park was appropriated \$500,000 annually earmarked to improve the ability of the existing bear management program to address the human–bear conflicts within the park.

One key element in the evolution of the bear management program in Yosemite occurred when the park’s wildlife managers realized that

the additional appropriation should be used to fund an even larger, multifaceted approach to addressing the increasing human–bear conflicts. Consequently, instead of simply increasing the wildlife budget, managers chose to fund an interdivisional team to combat the problem. As part of that endeavor, the Yosemite Bear Council (YBC) was formed. It was comprised of individuals from several divisions within the park, including wildlife management, law enforcement, maintenance, campgrounds, as well as other important organizations, such as the park's concessionaire and the Yosemite Association (a nonprofit group that provides funding and assistance to the park). The main objectives of the YBC were to foster cooperation and coordination among the different entities involved in the human–bear management program, to determine the appropriate course of action to resolve human–bear conflicts, and to evaluate the effectiveness of the program (National Park Service 2001b).

The newly-formed YBC oversaw the creation of the Human–Bear Management Interdivisional Program. The program funded additional seasonal and permanent positions that were dedicated to dealing largely or entirely with issues surrounding human–bear conflicts, particularly in Yosemite Valley and to a lesser degree in Tuolumne Meadows and the backcountry.

Park personnel began walking through each campsite nightly to speak to visitors face-to-face in an attempt to relay important information about proper storage of human food and garbage in the park. They also attempted to convey to skeptical park visitors that the presence of bears within the campground was not a theoretical concern, but a nightly event that was highly likely to occur.

Additional maintenance personnel were hired to expand garbage collection within the Yosemite Valley during the summer. Another key decision made by the YBC changed the park's garbage collection time from morning to evening. Previously, overflowing garbage cans and dumpsters throughout the campgrounds and picnic areas were left overnight, allowing bears to obtain human food and garbage easily when human activity was at its lowest. With this change, maintenance personnel cleaned picnic areas and emptied garbage cans after the

majority of human use was finished for the day. This resulted in a substantial decrease in the amount of human food and garbage available to bears.

In prior years, wildlife personnel walked parking lots around dusk, as time permitted, attempting to locate vehicles with bear attractants in them. Park personnel tried to locate the owners to have the food removed. As a result of the increase in personnel working for the program, this practice was greatly expanded. As an additional tool to eliminate potential bear incidents, a vehicle impound lot was constructed to allow vehicles containing bear attractants to be towed to this secure location when the owners could not be located.

Another key aspect of the program began during 1999 when funding was provided to hire wildlife management personnel to work 24 hours a day, 7 days a week for most of the year. This was important because food-conditioned bears in Yosemite Valley were most active during the night to avoid human activity. The around-the-clock availability of wildlife personnel to patrol Yosemite Valley, together with additional personnel to work with people to keep food inaccessible at night, dramatically increased the ability to focus on the bears themselves.

Park managers in 1987 adopted a policy of "mild aggression" (i.e., yelling and throwing rocks and sticks) toward black bears. They encouraged campers to be bolder in their attempts to discourage bears from entering their camp. By 1999, however, food-conditioned bears in Yosemite Valley were not discouraged by mild aggression. Many of the bears that frequented Yosemite Valley by this time had lost their natural avoidance behavior towards people and would readily enter campgrounds and picnic areas whether people were present or not. On several occasions in 1999, bears that had obtained human food or garbage were reluctant or unwilling to leave, despite wildlife personnel's use of mild aggression techniques toward them. When the bears would eventually move, it was often at a slow pace, stopping to investigate other possible sources of human food and garbage along the way. Recognizing the increased likelihood of human injury from such bear behavior, the YBC and the park in 2000 authorized the use of shotguns

and noisemakers for aversive conditioning of bears. Throughout that summer, wildlife personnel implemented aversive conditioning on 93 occasions and observed more positive behavioral changes in the bears, including their more readily leaving the area when park visitors used mild aggression toward them.

Since 2000, aversive conditioning has become an integral component of the human–bear management program. The effectiveness of aversive conditioning efforts varies greatly from bear to bear, based on its age, sex, previous exposure to humans and unnatural food sources, and other factors. However, anecdotally, there appears to be short-term benefits from the aversive conditioning to the majority of bears on which it is conducted and long-term benefits to many.

One particular female bear in Yosemite Valley, for example, was quite adept at breaking into vehicles, and she frequently obtained human food from them. Video footage of this bear coming out of a vehicle with a loaf of bread in her mouth has been included frequently in news stories and documentaries on Yosemite National Park over the past decade. However, on 2 occasions in 2000, this bear received aversive conditioning with bean bags, rubber bullets, and cracker-shell noise makers using a shotgun. Subsequent radio-telemetry and visual observations indicated that she had since remained primarily in the less-developed west end of Yosemite Valley and has not been documented breaking into vehicles.

This particular case undoubtedly represents the ideal benefit of aversive conditioning. Since aversive conditioning officially began, most bears it was used on became more elusive in developed areas. Some critics have suggested that this represents a shortcoming in the aversive conditioning because these efforts may not permanently persuade bears from coming into developed areas. However, at a minimum, it represents a partial shift in bear behavior back towards natural avoidance of humans. Bears that have undergone aversive conditioning have become more leery of entering and remaining in developed areas for long periods of time. They also typically cause less damage and obtain less human food and garbage per incident than they would have previously. As with any of the

individual components of bear management, aversive conditioning alone would not be successful without the simultaneous efforts of visitor education, the proper storage of human food and garbage, and regulation enforcement.

Throughout the history of Yosemite National Park, black bears that have consistently exhibited aggressive behavior toward humans or have entered tents or broken into cabins, have been killed by wildlife personnel. The number of bears killed for management reasons reached its peak between 1967 and 1972 when an average of 24 bears were killed per year immediately following the closure of the open-pit garbage dumps (National Park Service, unpublished report). Since the 1980s, wildlife managers have been more judicious in their removal of bears from Yosemite Valley, but they reluctantly administer euthanasia by lethal injection to approximately 1 to 5 bears a year.

In 2000, members of the Yosemite wildlife management staff joined with biologists and wilderness managers from Sequoia and Kings Canyon National parks and Inyo National Forest to form the Sierra Interagency Black Bear Group. The goal of the group regionally was to preserve a healthy black bear population free of human influences. Projects implemented by the group included the coordination of management policies, visitor information, and approval of food storage canisters to be used in the region.

Also beginning in 2000, the park commissioned the Wildlife Conservation Society to conduct a 3-year, comprehensive assessment of current human–bear conflicts in Yosemite Valley by examining both human and bear aspects of the conflict. The human aspect of the study assessed visitor behavior associated with bears in the park, food storage methods, and information dissemination. The bear aspect of the study focused mainly on assessing bear behavior toward humans in Yosemite Valley and the food habitats and movements of bears.

The research, which was completed in 2003, concluded that plant material made up 80% of the diet of bears in Yosemite Valley. The research also indicated that consumption of human food and garbage by bears in Yosemite Valley had declined by >70%, compared to that of the late 1970s (Wildlife Conservation

Society 2003). Bears captured during the study also weighed less than bears captured during research in the 1970s in Yosemite, but were similar in size to bears in less-developed areas of the Sierra Nevada mountain range (Wildlife Conservation Society 2003). This is likely due to bears returning more to their natural diet, as human food and garbage have become less available to them.

Several management recommendations in the assessment included continuing to address the multiple dimensions of human–bear management, applying stronger law enforcement efforts, conducting research on the patterns of habituation behavior (e.g., from sow to cub), conducting research on the effectiveness of aversive conditioning, combating the “I-already-know-it-all” attitude about the bear message among park visitors, producing signs that are vivid and brief, providing visitors with additional information on bear biology, continuing to provide the bear message via a variety of media, and assuring that food storage and garbage disposal systems are easy-to-use, accessible, and convenient throughout Yosemite Valley (Wildlife Conservation Society 2003).

During the fall of 2002, the park, in cooperation with researchers from the National Wildlife Research Center, began evaluating the effectiveness of automated data loggers that were installed within developed areas of Yosemite Valley. The data loggers consisted of a radio-telemetry receiver and a data-collection computer that detected all collared bears entering the area being monitored. During the winter of 2003, an alarm was added to the system that alerted bear management team members over park radios when a collared bear entered the area. This system quickly proved to be a valuable management tool by increasing the detection of individual bears, pinpointing their activity patterns (spatially and temporally), and allowing for greater opportunities to conduct aversive conditioning on them as they entered developed areas. The park now utilizes 6 data loggers located throughout the developed areas of Yosemite Valley during the seasons of bear activity.

Another tool used to combat the increasing number of human–bear conflicts in the backcountry areas of the park was a regulation requiring the use of park-approved food-stor-

age canisters within 7 miles (11 km) of major roads throughout the park. This regulation, adopted in 2004, was expanded during 2008 to require the use of approved food-storage containers in all backcountry locations. The Yosemite Association, which has provided canisters for voluntary rental since 1998, has increased the availability of canisters by continuing to purchase additional and replacement ones annually. The increased use of food-storage canisters has decreased the number of bear incidents in the backcountry.

Beginning in 2005, the wildlife management staff again collaborated with the National Wildlife Research Center to conduct a study evaluating the effectiveness of aversive conditioning. The study consisted of selecting bears considered to be highly food-conditioned and monitoring them 24 hours a day for a 7-day period. During this monitoring period, the bears received a high level of aversive conditioning every time they attempted to enter a developed area. Preliminary results of the study indicated that the monitored bears spent less time in developed areas, were involved in fewer human–bear conflicts, and obtained less human food during than before the monitoring period. Although this aversive conditioning technique proved to be successful in the short-term, the small sample size made it difficult to determine long-term behavioral changes (National Park Service 2007). However, because this technique has been successful, the park continues to implement it.

In 2006, the YBC agreed to fund a 3-year graduate research project through Montana State University. The project will focus on the detection of human food-conditioned bears throughout Yosemite using DNA stable isotope analysis. Additionally, the study will use DNA obtained from hair snags and samples taken during bear captures to examine if food-conditioned bears in the park are genetically related.

General analysis

To get a general idea of the effectiveness of the current management strategy, the number of bear incidents in Yosemite from 1990–1998 (pre-YBC) was compared to the number of bear incidents documented from 1999–2007 (post-YBC). These time periods

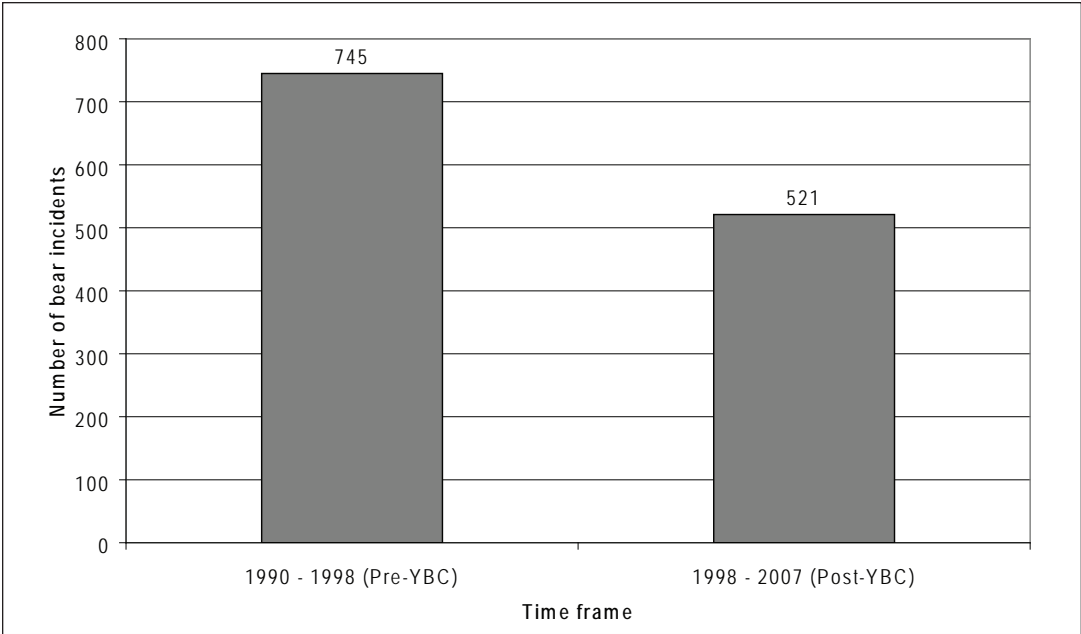


Figure 1. Average number of bear incidents per year in Yosemite National Park before establishment of the YBC (Yosemite Bear Council) and after the YBC was established.

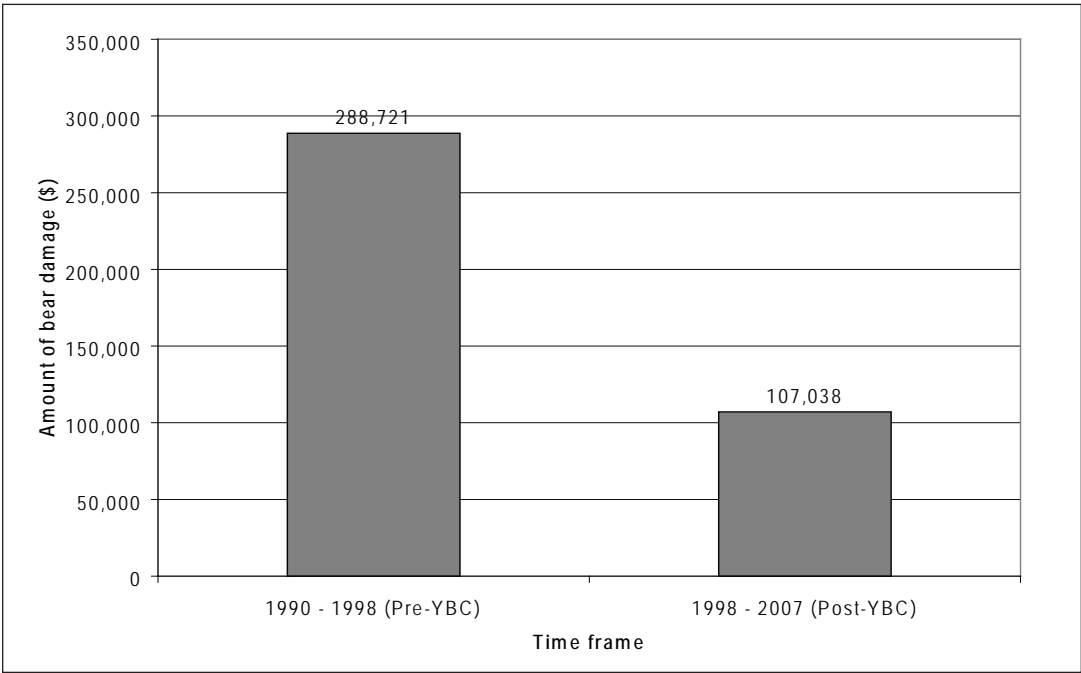


Figure 2. Average dollar amount of bear damage per year in Yosemite National Park before the establishment of the YBC (Yosemite Bear Council) and after the YBC was established.

were selected because 1999 was the first year of implementation of the interdivisional bear program and represented a substantial increase in human–bear management efforts within the park. All numbers are based on the Black Bear

Management and Incident Summary Reports produced by the park’s wildlife staff annually (National Park Service 1999, 2000, 2001*a*, 2002, 2003, 2005, 2006, 2007). During the pre-YBC period, an average of

745 bear incidents were recorded (ranging from a low of 445 to a high of 1,584; Figure 1) with an average cost of \$288,721 in damage annually (ranging from a low of \$113,796 to a high of \$659,569; Figure 2). Both the number of incidents and the amount of damage steadily increased during the last 4 years of this period. During the post-YBC period, the number of bear incidents per year averaged 521 (ranging from a low of 230 to a high of 768; Figure 1) with an average cost of \$107,038 (ranging from a low of \$32,303 and a high of \$224,341; Figure 2). It is worth noting that the highest number of incidents and damage during this time was during 1999, the first year the interdivisional program was implemented and the last year before wildlife personnel were authorized to conduct aversive conditioning. Based on the comparison of these 2 time periods, the number of bear incidents after the implementation of the interdivisional bear program decreased by an average of 224 incidents per year, representing a 31% decrease. Similarly, the average amount of damage caused by bears decreased by \$181,863 per year, representing a 63% decrease.

There is likely a greater reduction in the number of incidents and amount of damage than the numbers indicate. After the implementation of the interdivisional program in 1999, the park had a much greater capacity to locate and document bear incidents. With the addition of several staff positions working around the clock, 7 days a week, bear incidents that may have gone undocumented prior to 1999 were more likely to be detected.

Conclusion

Throughout its history as a national park, Yosemite has employed various management strategies to reduce human–bear conflicts, and its success has been as varied as the strategies themselves. However, with the establishment of the YBC in 1998 and the associated establishment of the Human–Bear Management Interdivisional Program in 1999, the park has made great strides in addressing the ongoing dilemma of managing a protected population of bears in a relatively small area that has a high degree of human use.

As park managers realize, no one tool alone will provide the solution to human–bear conflicts. The implementation of the

interdivisional program to address human–bear conflicts within the park was a key element to the success of the program. The effectiveness of the program relies on a combination of tools, such as effective communication with park visitors, proper storage of all human food and garbage, timely collection of garbage, aversive conditioning of bears entering developed areas, enforcement of regulations, and, unfortunately, removal of particular bears that display aggressive behavior. Park managers also recognize that it is only through these and many other efforts being executed simultaneously by the park and its many partners, such as concessionaires and nonprofit groups, that further reduction of human–bear conflicts within the park will result.

Another key factor in the success of the Human–Bear Management Interdivisional Program is the willingness of Yosemite to strive continuously to improve in all aspects of the program. For example, the food storage lockers are constantly being upgraded or retrofitted throughout the park, bear messages seen throughout the park are routinely updated, and wildlife personnel frequently add techniques into their arsenal of tools for monitoring bears and administering aversive conditioning to them. In addition, the YBC has been generous in funding a variety of research projects that have provided valuable insight into the bear side of the equation, as well as the human attitudes and understanding about human–bear management.

Despite all its efforts, Yosemite National Park continues to face a relatively high annual level of human–bear conflicts, and there are many areas of its management strategy that could be improved. However, park managers and, in particular, the YBC have demonstrated a dedication to the program and a willingness to be diligent both in maintaining the existing program and in continuing to explore new ideas for addressing human–bear conflicts that will serve the park and the bears well.

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